THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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ELECTRIC LIGHTING.

THE general report of the Select Committee of the House of Commons, appointed under the presidency of Dr. Lyon Playfair to consider whether it is desirable to authorise municipal corporations or other local authorities to adopt any scheme for lighting by electricity, and to consider how far, under what conditions, or if at all, gas or other public companies should be authorised to supply light by means of electricity, have now issued the following report, which, if it contains nothing new to any one who has studied the subject, has at any rate formulated in plain terms the present state of electric lighting, and decided that in the event of that mode of illumination fulfilling its present promise it will be wise to keep it out of the tentacles of the gas companies or any other large business monopolies. It will be remarked that the Committee do not urge any definite parliamentary action until the means of lighting have been still further improved, for in a system which is developing with remarkable rapidity, it would be lamentable if there were any legislative restrictions calculated to interfere with that development. They, however, recommend that local authorities should have full powers to test and aid in the development of the light. Summer is now here, and the sun himself has "scattered the rear of darkness thin," so that for the time being there is a cessation in the demand for electric lighting apparatus; but on the return of winter we may confidently expect a renewal of the activity in this direction which marked the same period last year. Mr. Edison obviously made a mistake in sending his famous cablegram on the 4th of October; but it was unfortunate only for his own sake and that of several timid holders of gas shares. His own inventive "thunder" indeed seems to have vanished in the flash of that fatal message; but it has had the effect of firing hidden mines of ingenuity in others which have given a great impetus to electric lighting. The report runs as follows :—

The general nature of the electric light has been well explained in the evidence of Professor Tyndall, Sir William Thomson, Dr. Siemens, Dr. Hopkinson and others. It is an evolution of scientific discovery which has been in active progress during the whole of this century. Essentially the electric light is produced by the transformation of energy either through chemical or mechanical means. The energy may be derived from a natural force, as for instance, a waterfall, or through combustion of a material in the cells of a voltaic battery, or of fuel in a furnace. The energy being converted into an electric current, may be used to manifest electric light by passing between carbon points, or by rendering incandescent solid bodies such as iridium. A remarkable feature of the electric light is, that it produces a transformation of energy in a singularly complete manner. Thus the energy of one-horse-power may be converted into gaslight, and yields a luminosity equal to 12-candle power. But the same amount of energy transformed into electric light produces 1,600-candle power. It is not therefore surprising that while many practical witnesses see serious difficulties in the speedy adaptation of the electric light to useful purposes of illumination, the scientific witnesses see in this economy of force the means of great industrial development, and believe that in the future it is destined to take a leading part in public and private illumination. There is one point on which all witnesses concurred, that its use would produce little of that vitiated air which is largely formed by the products of combustion of ordinary illuminants.

Scientific witnesses also considered that in the future the electric current might be extensively used to transmit power as well as light to considerable distances, so that the power applied to mechanical purposes during the day might be made available for light during the night. The committee only mention these opinions as showing the importance of allowing full development to a practical application of electricity, which is believed by competent witnesses to have future important bearings on industry.

So far as the practical application of the electric light has already gone, there seems to be no reason to doubt that it has established itself for lighthouse illumination, and is fitted to illumine large symmetrical places, such as squares, public halls, railway stations, and workshops. It is used in Paris for lighting shops which require a light by which different colours may be distinguished, and has recently been used in England for the same purpose with satisfactory results. Many trials have been made for street illumination with greater or less success.

Compared with gas, the economy for equal illumination does not yet appear to be conclusively established. Although in some cases the relative economy for equal candle power is on the side of the electric light, yet, in other cases, gas illumination of equal intensity has the advantage. Unquestionably the electric light has not made that progress which would enable it in its present condition to enter into general competition with gas for the ordinary purposes of domestic supply. In large establishments the motors necessary to produce the electric light may be readily provided, but, so far as we have received evidence, no system of central origin and distribution suitable to houses of moderate size has hitherto been established.

In considering how far the Legislature should intervene in the present condition of electric lighting, the committee would observe, generally, that in a system which is developing with remarkable rapidity, it would be lamentable if there were any legislative restrictions calculated to interfere with that development. The committee, however, are not in a position to make recommendations for conditions which may hereafter arise, but at present do not exist, as to the distribution of electric currents for lighting private houses from a central source of power. No legislative powers are required to enable large establishments, such as theatres, halls, or workshops, to generate electricity for their own use.

If corporations and other local authorities have not power under existing statutes to take up streets and lay wires for street lighting and other public uses of the electric light, the committee think that ample power should be given them for this purpose. There seems to

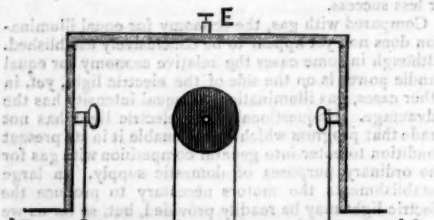
be some conflict of evidence as to whether the existing powers are sufficient or not. But even in regard to local authorities it would be necessary to impose restrictions upon placing the wires too near the telegraph wires used by the Post Office, as the transmitting power of the latter would be injuriously affected by the too close proximity of the powerful electric currents needed for producing light.

Gas companies, in the opinion of the committee have no special claim to be considered as the future distributors of electric light. They possess no monopoly of lighting public streets or private houses beyond that which is given to them by their power of laying pipes in streets. Electric light committed to their care might have a slow development. Besides, though gas companies are likely to benefit by the supply of gas to gas-engines which are well suited as machines for producing electric light, the general processes of gas manufacture and supply are quite unlike those needed for the production of electricity as a motor or illuminant.

The committee, however, do not consider that the time has yet arrived to give general powers to private electric companies to break up the streets, unless by consent of the local authorities. It is, however, desirable that local authorities should have power to give facilities to companies or private individuals to conduct experiments. When the progress of invention brings a demand for facilities to transmit electricity as a source of power and light from a common centre for manufacturing and domestic purposes, then, no doubt, the public must receive compensating advantages for a monopoly of the use of the streets. As the time for this has not arrived, the committee do not enter into this subject further in detail than to say that in such a case it might be expedient to give to the municipal authority a preference during a limited period to control the distribution and use of the electric light, and failing their acceptance of such a preference, that any monopoly given to a private company should be restricted to the short period required to remunerate them for the undertaking, with a reversionary right in the municipal authority to purchase the plant and machinery on easy terms. But at the present time the committee do not consider that any further specific recommendation is necessary than that the local authorities should have full powers to use the electric light for purposes of public illumination, and that the Legislature should show its willingness, when the demand arises, to give all reasonable powers for the full development of electricity as a source of power and light.

DR. OLIVER J. LODGE'S ELECTROMETER KEY.

THE ordinary ebonite reversing keys used in testing differences of high potentials are open to several objections. For example, they leak considerably, owing to surface moisture, and a coating of sulphuric acid, which corrodes the brass; they have a considerable capacity, owing to the size of their metal parts; and the hand comes too close to them in manipulating them. The new double reversing key, designed by Dr. O. J. Lodge, and exhibited by him at the *conversazione* of Telegraph Engineers, is intended to overcome these drawbacks by giving a high insulation, small capacity, and not requiring the hand to approach close to the effective parts in working it. The nature of the key will be seen from the accompanying figures, which represent one-half of the double key in side and front sections. Four platinum wires are arranged in pairs crossing one another at right angles, one pair, *a*, *b*, crossing midway between the other two, *c*, *d*. These are provided with terminals, and form the contact pieces of the key. They are supported in their places by vertical silk cords stretched by springs as shown, the middle pair, *a*, *b*, however, being suspended by an endless silk cord which runs on two pulleys, the upper having a handle, H, which appears outside the case, and is worked by the operator's hand. The lower pulley is stretched by a spring, *s*, so as to keep the endless cord taut. The whole is enclosed in a brass case, which is put to earth by



the terminal E when the key is in use. There are three positions of the handle H, corresponding to three acts on the part of the key; when the handle is in its mid-position, both sets of wires are insulated from each other; when to the right, *a* makes contact with *c*, and *b* with *d*; when to the left, *b* makes contact with *c*, and *a* with *d*. These positions are determined by three small holes in the side of the case, into which a spring stud shown inside the handle falls. With the complete key four different positions can be obtained.

THE INTERNATIONAL DELEGATES IN ENGLAND.

THE delegates of the International Telegraph Conference assembled for their first official sitting, on Tuesday, June 10th, at No. 1, Grosvenor Place, where they were courteously welcomed by the Postmaster-General, Lord John Manners. General Leuders, Director-General of the Russian Telegraph Administration, made an appropriate reply, and the business of the day was forthwith begun under the presidency of Mr. Patey, of the Postal Telegraph Department.

The Conference comprises an imposing array of distinguished men, some of whom are well known to the public at large, and, in respect of attendance at least, the London meeting must be considered the most important which has yet been held. The names of the delegates are as follows:—

Austria: M. W. Devez, Postmaster-General, Dr. Brunner von Wattenwyl, Director of Austrian Telegraphs, Count Victor Wimpffen, Inspector-General of Telegraphs, and a Secretary; *Belgium:* M. J. Vinchent, Director-General of Posts and Telegraphs, and M. Gibbs, Chief Inspector of the Telegraph Service; *Denmark:* Captain H. Höncke; *Germany:* Herr Budde, Director of the General Telegraph Office, Herr Gunther, Upper Privy Councillor of Posts, Herr Scheffler, Privy Councillor of Posts, Herr von Gumbart, Telegraph Director, and Herr Magalle, Secretary of General Telegraph Office; *Great Britain:* C. H. B. Patey, H. C. Fischer, and P. Benton; *Greece:* M. J. Gennadius, Chargé d'Affaires, London; *Hungary:* M. von Koller, Director of Telegraphs; *Italy:* Signor Commendatore, Ernesto d'Amico, Director-General of Telegraphs, and Cav. Berliri, Inspector of Telegraphs; *India:* Col. Champain, Director-General, and Mr. Brasher; *Japan:* M. Yoshikama Akimasa, Head of Telegraph Bureau, and a Chief Secretary of Ministry of Works, and M. Munchiro, Nakano; *Netherlands, The:* Mr. Staring, Director of Telegraphs; *New Zealand:* Sir Julius Vogel; *Norway:* Mr. Nielson, Director-General, and Mr. F. Bugge, Inspector; *Portugal:* V. Do Rego; *Russia:* General C. de Leuders, Director-General, and M. P. Salmonwitch, Chef de Section; *Sweden:* Mr. D. Nordlander, Director-General, and Mr. C. Akerlund, Secretary; *Switzerland:* Mr. Frey, Director-General; *Victoria:* Right Hon. Hugh Childers, M.P.; *Bureau International:* M. Curchod, Director, and M. de St. Martial, Secretary; *Anglo-American Telegraph Company:* H. Weaver; *Brasilian Submarine:* T. Fuller; *Cuba Submarine:* T. Hughes, Q.C.; *Direct Spanish:* C. Gerhardi; *Direct United States:* Captain R. Mayne, R.N., and J. W. Fuller; *Eastern, Eastern Extension, Australasia, and China:* John Pender, M.P., Sir James Anderson, Col. Glover, Lewis Wells, and Jules Despecher; *Black Sea:* Julius Beer; *German Union:* Dr. Lovard; *Great Northern:* H. G. Erichsen, Captain E. Suenson, and Captain W. von Hedemann; *Indo-European:* W. Andrews, Dr. C. W. Siemens, F.R.S., and F. Moll; *Mediterranean Extension:* E. A. Tombs; *Submarine:* Sir J. Carmichael, Bart., Sir J. Goldsmid, Bart., M.P., Arthur Otway, M.P., and S. M. Clare; *West Coast of America:* R. K. Gray; *Western and Brasilian:* Major Wood; *France:* M. J. Richard, Engineer-Director of Telegraphs, M. E. Eschbalcher, Chief Officer of Section at the Postal and Telegraph Department; *British India:* Major H. Mallock; *Servia:* M. Radoykorits, Chief of the Postal and Telegraph Department; *Roumania:* M. Robescu, Director-General of Telegraphs; *British Colonies:* Victoria, The Right Hon. Hugh C. E. Childers, M.P.; South Australia, Sir W. Milne; New Zealand, Sir Julius Vogel, K.C.M.G.

Since their arrival in our midst the foreign delegates have been entertained in a variety of ways; and it is gratifying to find that something has been done to enliven their labours, and inspire them with pleasant memories of "Old England." We are believed to be a cold and proud race by the people of other nations; but perhaps our visitors will henceforth do us the justice to remember that the Englishman abroad is a different being from the Englishman at home, the only place perhaps where he is truly himself.

The Lord Mayor first did the honours of the country to the delegates by inviting them to a banquet at the Mansion House, along with the members of the International Literary Congress on June 12. The following Saturday forenoon they were shown by Dr. C. W. Siemens, over the Telegraph Works at Charlton, where they had an opportunity of witnessing the manufacture and shipping of the new French Atlantic cable, and were afterwards refreshed with luncheon.

On the evening of June 17, a dinner was given in their honour by the joint-reception committee of the Conference at the Freemason's Tavern; Mr. John Pender M.P. occupying the Chair. Many toasts were drunk, and the meeting passed off very happily. Mr. Pender remarked that fifteen years ago there were little more than 2,000 miles of submarine cable in existence, whereas now there were about 66,000 miles, representing a capital of £25,000,000; he advocated the adoption by the Congress of liberal terms to the Press, and hoped that the day was not far distant when all the telegraph lines of the world would be united in a single system. This noble and cosmopolitan sentiment was loudly cheered, a fact which need not surprise us when we remember that it had been preceded by an excellent dinner. Dr. Brunner von Wattenwyl, responding in French, observed that the Congress represented progress by a union of the spirit of conciliation and conservatism, two great principles which had found their brightest illustration in the history of Great Britain. Lord Bury proposed "Our Colonial Empire United by Telegraph."

A visit was also paid by the delegates to the Crystal Palace on June 14, when a most enjoyable afternoon was spent among the galleries and gardens. In the evening the joint reception Committee of the Post Office and Telegraph Companies entertained them at dinner in the Palace, a large number of ladies being present, and Mr. Thomas Hughes, Q.C., the well-known author of "Tom Brown's School Days," in the Chair. In proposing the toast of the evening he said, "Amongst present signs there are few more hopeful than this, of the gathering together, year after year, in friendly conference of those whose work it is to speed and develope the intercourse of nations. It has been our pride hitherto to gird the whole earth with our speaking gear. Already there is scarcely a corner which we have not reached. We have already grounds for the proud motto, '*Qua regio in terris nostri non plena laboris?*' Let us then go on hopefully; in faith that, as intercourse grows and men know more and more of each other, a sounder and better mind will grow also,

which will inform and inspire that intercourse and make it a sure, and no longer a doubtful blessing to mankind. Let this then be your and our effort, to cultivate in all ways this better and wiser mind—each of us in ourselves, each of us amongst our own people—that these marvellous agencies which are bringing us all more and more closely together, whether we like it or not, may bring us together as friends and brothers, bearing each other's burdens, sharing each other's hopes, rejoicing in each other's progress."

Signor D'Amico made a very graceful reply in French. He said, "My colleagues and myself are very grateful for the welcome, at once so splendid and so cordial, which has been accorded to us in this country; and we are happy to take advantage of any opportunity which presents itself of thanking the Government of England the municipality of the capital, and the telegraph companies for the testimonies of sympathy which they have been so good as to exhibit (cheers), and of expressing our admiration of the General Post Office, of the City of London, and of the various private telegraphic enterprises which are carried on after the manner of the English (hear, hear). I may say to you, ladies and gentlemen, that we deserve to be loved a little by England, since we love her so much (cheers). We have learned from our youth upwards to consider this country as that in which the most intimate alliance exists between order and liberty, between tradition and progress, between moral work and material work, between all classes of society, between the dynasty and the nation (cheers). The spectacle which has unrolled itself before our eyes since we have been here, whilst confirming and strengthening the lessons we have learned, gives us an explanation of the marvellous destiny to which the English people have been called by Divine Providence."

The delegates also paid a visit to Richmond, the "Tusculm" of England's Metropolis, on Saturday, June 21st, where they were entertained at dinner in the "Star and Garter Hotel," by the joint-reception committee of the Post Office and Telegraph Companies. Colonel Holland presided, and M. Vinchent, in response, alluded to England as the birthplace of practical telegraphy, and that happy land where every man could freely express his opinions, whether on telegraphy or anything else.

The other important festivals celebrating the stay of our distinguished guests were the *conversazione* of the Society of Telegraph Engineers, and the visit of the delegates to the India-Rubber and Gutta-Percha Telegraph Company's Works at Silvertown, the first of which events is fully described in another part of the present number. The excursion to the Silvertown Works was a very successful and highly interesting affair. It took place on Thursday, June 19th, the day following the *conversazione*, and was attended by a great number of distinguished men connected with telegraphy. A choice luncheon regaled the party after the various manufactures of the works had been reviewed.

THE CONVERSAZIONE OF TELEGRAPH ENGINEERS.

SELDOM indeed has a scientific *soirée* in London been so successful, brilliant, and agreeable as the *conversazione* of the Society of Telegraph Engineers which took place on the evening of Wednesday, June 18, upon the occasion of the presence of the foreign delegates of the International Telegraph Congress. The western galleries of the South Kensington Museum had been kindly lent by the Committee of Council on Education for the purpose, and all their rich store of scientific treasures, instruments, models, and archæological weapons was exposed to view—a serene and philosophical environment to the purely electrical and telegraphic apparatus which formed the special feature of the exhibition. These galleries were lit by gas, but the open balcony overlooking the gardens of the Horticultural Society was flooded with the artificial day shed from four Siemens' electric lights, hung aloft high overhead like mimic suns. The light streamed down steadily from these dazzling cressets and illuminated the gardens far and wide, enhancing the deep green of the leafy trees, and throwing a kind of romantic glamour over the scene. Part songs, band music, choice refreshments, and, above all, the presence of many distinguished electricians and men of famous note in telegraphy, combined to make the evening as memorable as it was pleasant. The display of electrical apparatus was remarkably fine, and completely wipes away any reproach attaching to British makers for the miserable show which represented their work at the late Paris Exposition.

Taking these objects in the order of the printed catalogue, the spectator was at once arrested by the giant inductorium of Mr. Alfred Apps, the property of Mr. Spottiswoode. The sparks emitted by this powerful induction coil were sometimes 42 inches in length—a veritable lightning flash in miniature. Blocks of glass 1½ inches thick which had been pierced by the discharge were also on view, the clear brittle material having been ground to whiteness along the track of the electric energy. Mr. Latimer Clark exhibited a collection of rare books on magnetism and allied subjects; his oxy-hydrogen mirror galvanometer for indicating delicate electric currents to large audiences; and several interesting antiquities of the craft, such as a portion of the original telegraph line laid by the late Sir Francis Ronalds in 1816, and the original type cast for the Morse instrument.

Messrs. Latimer Clark, Muirhead & Co. exhibited 800 knots of Muirhead's artificial cable, made according to the type of the Malta-Gibraltar section of the Eastern Telegraph Company's system. The construction of this apparatus, by which over 9,000 miles of submarine cable, including the direct United States Atlantic cable, have been duplexed, was fully illustrated by Dr. Muirhead in the TELEGRAPHIC JOURNAL for May 15 and June 1, 1879. A specimen of the interior of one of the boxes, and of the gilt insulated wire for landline duplex, described in these Journals, was also shown. The artificial cable was connected up for duplex working on the Wheatstone balance method, with a Brown and Allan's Relay for receiver at one end, and Sir William Thomson's Siphon Recorder at the other. Messrs. Clark and Muirhead also displayed a variety of apparatus, including Clark's standard elements, small chloride of silver cells, resistance coils, &c. Of these we may specially mention a standard condenser made of mica, coated with shellac, purified with absolute alcohol; Mr. Saunder's new key for signalling on submarine cables by the addition of rubbing contacts to the ordinary pressing contacts; and Mr. Graham's key for use in the Wheatstone Bridge, with the advantage of high insulation from there being no connections under

the ebonite, and wider spaces than usual between the binding screws.

Mr. Conrad W. Cooke exhibited Sykes' electric lock and block system for railway working, and an ingenious new galvanometer of his own invention for demonstrating the internal current in a voltaic cell. The plates of the cell under test are immersed in the liquid at the upper ends of a curiously blown glass tube, which would have the form of a U tube were it not that the bent portion is drawn out fine and coiled into a spiral, in the middle of which is hung a galvanometer needle. The internal current passing through the liquid in the glass spiral tells its presence by deflecting this needle.

Cowper's Telegraphic Pen; Crossley's Microphone (described in our issue for May 1); Firnhaber's patent synchronous electric clocks, exhibited by Messrs. Edmundson & Co., were also to be seen at work.

Messrs. Elliott Brothers maintained their high reputation as electrical mechanicians by a fine display of galvanometers, keys, and resistance coils; and Mr. Groves exhibited a finished specimen of the Induction Balance of Professor Hughes. An audiometer was also shown by Messrs. Krohne and Lesemann.

The India-Rubber and Gutter-Percha Telegraph Works Company displayed many specimens of their varied manufactures, from submarine cables and dynamo-electric machines, to medical batteries and torpedo fuzes.

The centipede grapnels of Messrs. Johnson and Phillips, which admit of new prongs replacing broken ones, and their patent cutting and holding grapnel for the recovery of cables in deep water, were on view, together with a machine for testing wire by torsion, and a simple but ingenious lead sinker designed by Mr. F. R. Lucas.

The Postal Telegraph authorities made a very extensive exhibit of instruments, old and new, batteries, and testing apparatus. The Bell Telephone Company also set forth a variety of neat ebonite telephones, call bells, and indicators. Messrs. Siemens Brothers exposed a large assortment of electric lamps, including the pattern employed in the Lizard lighthouse, having 22 inch carbons between the holders; and the small Berlin regulator fitted with a 15 inch glass globe, half frosted. Field telegraphs, electric testing instruments, including Dr. Obach's galvanometer, magneto-electric exploders for mining operations, Siemens' lightning guards, and Petri's speed indicator, were also contributed by this well-known firm.

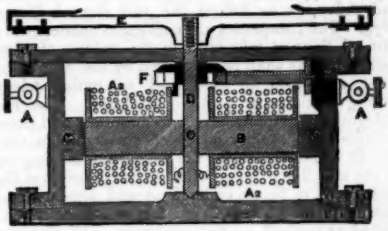
Numerous specimens of submarine cables were exhibited by the Telegraph Construction and Maintenance Company, which illustrated in an interesting manner the comparative anatomy of these terrestrial nerves; and a specimen of the Arica-Iquique section of the Peru Cable (which weighs 5 tons per nautical mile) was exhibited by the West Coast of America Telegraph Company, showing the break caused by the earthquake of May, 1878, in 60 fathoms of water.

There were many other objects of interest which we must perforce omit in this cursory review; for example, the mechanical duplex telegraph and the pneumatic submarine recorder of Mr. Theiler, the marine azimuth compass of Sir William Thomson, and the De Mersanne electric regulator of Mr. Bernard Godfrey. We shall, however, publish full descriptions of some of these novelties from time to time. The electric regulator of M. Hospitallier and the electric mounting table of Mr. F. M. Rogers, are illustrated on another page.

The new patent battery of Mr. W. S. Wilson, of Sunderland, appears to us, however, of sufficient promise to merit a place here. Judging from the specimens exhibited, there is no apparent local action, and the cell is said to be very constant. It consists of three vessels: the inner, which is porous, contains a carbon plate immersed in sulphuric acid and water saturated with nitrate of soda and bichromate of potash; the intermediate, which is of glazed porcelain, supports the zinc plate on its upper edge as a ring, and contains a paste of di-oxide of manganese and sulphuric acid and water, overlaid by moist sand; the outer vessel of stoneware contains simply water. The electro-motive force of this cell is 2 volts, and its internal resistance 1 ohm. We understand that it is being tried just now on the postal telegraphs.

AN ELECTRICAL MOUNTING-TABLE.

THIS little instrument, devised by F. M. Rogers, 29, Moorgate Station Buildings, is intended to supply a want which every user of the microscope must have felt. By the old plan, the table for putting the rings of varnish upon the slide holding the object had to be kept in motion by the left hand, and an uneven constantly varying speed



resulted. Here electricity is the source of power, which is utilised in the following way:—Two wires, from a small bichromate battery, are fixed to the terminals marked A, one of which is connected with the spring and circular contact breaker F. Supposing the spring touches one of the teeth of the wheel, a current traverses the wire A_2 upon the bobbin fixed upon the two arms of the rotating iron bar B. The bar is instantly converted into a powerful magnet, which turns towards the top of one of the inclined planes (of which there are a corresponding number to the teeth in the circular contact breaker), cast in the wall of the iron box. Just before reaching the top the contact is broken, the current ceases, and also any tendency to retard the

rotatory motion imparted to the table E, fixed by the spindle D, to the bar B. Any desired rate of speed can be obtained by regulating the amount of zinc exposed to chemical action.

THE CAPE CABLE.

THE s.s. *Kangaroo* had arrived at Durban on May 21 with the Natal to Zanzibar section of the Cape Cable. The second section is on its way in the s.s. *Seine*, and the *Calabria* is expected to sail before long with remainder. Difficulties have arisen respecting the subsidy voted by Natal towards the establishment of telegraphic communication with England. When under discussion by the House of Assembly, it was understood to be dependent upon the terminus being within the Natal borders, and the Colonial Secretary has sent a despatch to the Home Government stating that, as this condition was not to be complied with, he did not feel juitified in ratifying the arrangements of the Crown agents. At a meeting of the Chamber of Commerce, which Mr. Forde, the engineer of the colony, attended and addressed, a resolution was passed expressing the hope that the Government would reconsider their decision, and, although the strict letter of the agreement has not been fulfilled, still that was not sufficient reason for withholding the subsidy. It is confidently believed that all the difficulties will be readily overcome. The greatest objection to the terminus is that, owing to the frequent thunder-storms in the summer, the land wire thence is very frequently out of repair. An alternative route, via Pretoria, is now in course of construction.

The agreement between the Government and the contractors requires that the cables shall be capable of transmitting 14 words a minute; and that the company shall, save in case of *force majeure*, have the portion of the cable between Durban and Zanzibar, laid and open for the transmission of messages on or before the 31st day of July, 1879, and the portion between Zanzibar and Aden, on or before the 31st day of December, 1879. The companies are entitled to connect the cable with all lines of telegraph in the colony of Natal at such points as shall be approved by the Natal Government, and with all land and submarine telegraphs having stations or termini at Aden. The Eastern Telegraph Company agrees to maintain and provide a suitable and properly equipped steamship in the Red Sea or Indian Ocean for the purpose of making repairs to the said line of submarine telegraph between Durban and Aden, it being understood and agreed that such steamship may be employed for repairs to other lines owned or worked by that company. All Government messages (whether Imperial or Colonial) are to have priority to all other messages, at rates equal to one-half of those charged to the general public. The stations on the line are to be open from eight a.m., until eight p.m., and throughout the night, when there is any traffic to forward, or when specially required by her Majesty's Government (whether Imperial or Colonial) to be open. It is provided that the rates to be received by the company owning or working the line for messages (other than Government messages) transmitted thereby, exclusive of charges payable to other companies or administrations, shall not exceed the following; that is to say—between Durban and Aden, and vice versa, 5s. a word; between Zanzibar and Aden, and vice versa, 4s. a word; between Aden and London, and vice versa, by any of the lines of the said Eastern Telegraph Company, a total charge of 3s. 9d. a word. And the said rates shall not be increased without the previous consent of the official director, to be appointed. Her Majesty's Treasury may nominate an official director on the boards of the companies owning and working the line, to whom every information and assistance in regard to the said line must at all times be afforded. Her Majesty's Treasury after the date of the effective completion of the line of telegraph between Durban and Zanzibar, and the opening thereof for the transmission of messages, agrees to pay during the term of 20 years an annual subsidy or yearly sum of £17,500, and a like sum on account of the line between Zanzibar and Aden. The payment of these sums is made conditional on the line being kept in good working order. In case of war, rebellion, or other emergency, the Imperial Government of the United Kingdom, or the Government of any British Colony or possession duly authorised by her Majesty's Government in that behalf, may take possession of the cables, stations, offices, and apparatus on the line, and keep possession thereof for so long as they may think requisite, and the companies and their successors in business shall do all in their power to enable the Government to have and enjoy the benefit and advantage thereof. For this privilege the Government agree to make such compensation to the company as shall be admitted or determined (in case of dispute) by arbitration to be reasonable. The last clause provides that the agreement shall not be binding until it has been approved by a vote of the House of Commons.

RESEARCHES WITH PROFESSOR HUGHES' AUDIOMETER.

By BENJAMIN WARD RICHARDSON, M.D., LL.D., F.R.S.*

PROFESSOR HUGHES having done me the honour to show me first his newly invented instrument for the measurement of hearing, and having supplied me with an instrument for the purpose of testing the application of it for physiological and practical purposes, I have been enabled to make a considerable number of experiments, on which I venture to submit the following preliminary report:—

The instrument, as it has been used, is before the Society. It consists of two Leclanché's cells for the battery, a new and simple microphonic key connected with the cells and with two fixed primary coils, and a secondary or induction coil the terminals of which are attached to a telephone. The induction coil moves on a bar between the two fixed coils, and the bar is graduated into 200 parts, by which the readings of sound are taken. The graduated scale is divided into 20 centims., and each of these parts is subdivided into 10, so that the hearing may be tested from the maximum of 200 units to 0°—zero. The fixed coil on the right hand contains 6 metres of wire; the fixed coil on the left hand contains 100 metres. By this means a long scale from the left hand coil is produced. The secondary coil contains 100 metres of wire.

In using the instrument, one Leclanché's cell has been found sufficient, as a general rule, but two have been used in instances where the hearing of the person under test has been very defective. The Leclanché cell was selected by Professor Hughes as affording a reliable current for the purposes he had in view, and for standard comparisons. In using the instrument, the induction coil is moved along the scale from or towards the larger primary, as may be required, and the degrees or units of sound are read from the figures on the scale, the

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sound being made by the movement of the microphonic key between the battery and the primary coils.

The person whose hearing is being tested should sit in an easy position, and should not see the act of the observer in moving the microphone key. For good observation, the room in which the experiment is made should be large, and all external causes of sound, such as the ticking of clocks, the vibrations of windows and doors, the moving of feet and the singing from gas jets, should be silenced. The sitter should close the ear that is not applied to the telephone while he is listening for minute sounds, and should give his full and calm attention to the proceeding. Any excitement is like to lead to error when refined measurements are required.

The instrument may be considered to afford the most satisfactory means for testing the hearing power of all persons who can define a sound. The range of sound is sufficient at the maximum—200°—for everyone who is not absolutely deaf; 0°, or zero, is a point of positive silence from the instrument, or rather from the sound which it produces through the telephone.

One of the first facts learned with the audiometer is the suddenness with which the sound is lost to those who are listening. The sound is abruptly lost within a range of 2°; that is within one-hundredth part of the entire scale. This is the case with those who are very deaf as well as with those who hear readily, a fact originally noticed by Mr. Hughes, and which I have corroborated by fifty special observations on different persons presenting powers of hearing which varied from 200° to 140° as the extreme limit or capacity, to complete hearing through the whole scale, down to zero. In these persons, when the observation was taken, under the strictest possible conditions for surrounding silence, the point between distinctness of sound and complete loss of it was not more than one-hundredth part of the scale.

In testing the capacity of hearing, it is noticeable that the power to detect the diminishing sound is maintained best by continuing the reduction in trace or line while the attention is fixed. A sudden break may cause the sound to be lost to the listener long before his real incapacity to hear is reached. If, for instance, the sound be very faintly heard at 15°, and the induction coil be suddenly moved to 5°, the sound at 5° may be quite inaudible; but if the coil be slowly moved, unit by unit, from 15° to 5°, the sound at 5° may be distinctly heard. Mr. Maitland Tate, C.E., who noticed this point very markedly in his own case, when I was submitting him to test, compared this to what is observed by the sense of sight in making surveys. The eye will follow a line to an extreme point with comparative readiness, but if it break away from it, the object seems to have disappeared.

The effect of filling the chest and holding the breath makes a difference in listeners. The capacity for hearing is for a few seconds increased by holding the breath. Mr. Tate, who could hear with his right ear only down to 8° under ordinary breathing, could hear down to 5° when he held his breath. Another gentleman, who could hear only down to 100° under ordinary breathing, could hear to 80° when the breath was held with the chest full. Holding the breath with the chest not full fails to produce the same result.

As a rule, the hearing of persons who are right-handed is most refined in the right ear, and as most persons are right-handed, it is found that the right ear is the best ear. This rule is, however, attended with many exceptions, since, for various reasons, some persons who use the right hand exclusively, practise for some particular purpose the use of the left ear, upon which that ear becomes more acute. Thus five physicians, who were right-handed but who had accustomed themselves to use the stethoscope with the left ear, could hear to zero on that side, but had lost from 4° to 5° on the right side. Four other persons who were similarly circumstanced were able at once to account for the fact by the habit they had acquired of listening to a public discourse or sermon from the left side. Another point of interest attaching to this observation is, that the practice of using one ear for special refinement of the sense seems for the time slightly to impair the other ear, although there is no physical evidence of such impairment.

Connected with last-named fact is another, namely, that by this instrument the deaf are found to fail in capacity of hearing not only by reason of physical defect, but also by failure of memory of sounds. Thus in a youth who had suffered serious defect of hearing for seven years, owing to partial destruction of the tympanum, and who in the right ear could only detect sound at 107°, there was an inability to catch all the sound lying between 130° and 107°, until he could remember what he had to listen for. By practising him then to detect the lowest sound that he was physically capable of receiving, I got him to detect this one sound more readily than those which came higher up. By further practice all the intervening sounds became audible with equal facility. These facts which have been confirmed by another observation on a different person, seem to me to indicate that deafness from imperfection of the tympanum or other parts of the organ of hearing may be increased, beyond the mere physical failure, either from some lost power of automatic adjustment in the auditory apparatus, or from failure of receptive power in the cerebrum itself, so that the memory rendered imperfect is slow to assist the listener until by exercise of function its readiness is restored.

By use of the audiometer, the influence of atmospheric pressure on hearing is detectable. In my own case when the barometer is at 30° I can hear on both sides close down to zero; but below 30° I fail by 2° on the left side to reach zero. In another person a similar failure extends to a loss of 4°.

I have tried to determine in some of the lower animals whether there is the same sense of hearing as in man. In most animals it is difficult to obtain sufficient quietude to enable the observer to gather from expression or movement of the animal the information sought for. In two dogs, one a terrier, the other a field spaniel, I succeeded in making some good observations, and in them the range of hearing power seemed to be distinctly lower than it is in the human subject who has perfect hearing. In both these animals, which were healthy, and in the prime of life, the first indication of the detection of sound commenced at 10° on the scale. The detection was evidenced by the sudden expression of listening, by a slight change of position, and a slight dilatation of the pupils. This detection was clearly made on the instant, as if the sharp line or hearing were the same in them as it is in the higher animal.

PRACTICAL MEMORANDA.

1. The audiometer will, I think, be an essential in all physical examinations of men who are undergoing examination as to their fitness for special services requiring perfect hearing, such as soldiers, sentries, railway officials, and the like.

2. The instrument will be of great use to the physician in determining the value of hearing in those who are deaf, and in determining the relative value of the two organs of hearing. In one instance, already, I have been able by its means to detect in a person who was supposed to be equally deaf on both sides, that on one side the hearing is perfect close up to zero, while on the other side nine-tenths of the hearing is lost.

3. In other forms of diagnosis I have found the in-

strument useful. In a young person suffering from acute anæmia the hearing was so defective that on the right side it failed to detect sound at 18°, and on the left side at 15°. In ten days, during which, under a new regimen, great improvement took place in strength and general condition, the power of hearing had so much improved that the right ear was good down to 12°, and on the left to 3°; an improvement of 6° on the right and of 12° on the left side.

In another person who was subject to repeated vertigo, the giddiness occurring three or four times a-day, the hearing was so defective that although the external ear on each side was clear and the tympanum natural, no sound could be heard below 30°. Under complete rest and attention to diet, the vertiginous attacks were in a few days removed altogether, and with that removal there was gain of hearing, on both sides equally, up to 5° on the audiometric scale.

4. The instrument may be used to differentiate between deafness through the external ear and deafness from closure of the Eustachian tube,—throat deafness. In my own case I fail to detect sound by the mouth at 170°, and this I find is a fair average in those who are healthy. It represents the comparative value of communication by sound through the Eustachian canal and the external ear.

5. The instrument promises to be very useful in detecting the effects in the body of those agents which quicken or excite the circulation, such as alcohol and other similar chemical substances. I have some observations on these points in reserve for a further report.

6. The instrument promises to be of great service in determining the value of artificial tympanums in instances of deafness due to imperfection or destruction of the natural tympanum. The cotton artificial tympanums introduced originally by the late Dr. Yearsley, and the membranous tympanums introduced by the late Mr. Toynbee, F.R.S., have proved of much service; and by means of the audiometer I have been able very accurately to test their respective merits and to compare both with tympanums made of other material. The enquiry has led me to test different metals for this purpose, and to find in fine gold the substance for making the most useful and effective artificial drum. The Messrs. Ash, of Broad Street, have made for me various forms of gold drums, the best of which, perhaps, is a little cylinder which, with other forms, is placed before the Society. With one of these cylinders I was able to give to a young gentleman who had lost hearing on the right side up to 110°, from destruction of the tympanum, an instant gain down to 60°, a gain of 50° on the audiometric scale.

In this preliminary report I have omitted many subjects of interest, but I hope I have related enough to show that the world of science in general, and the world of medicine in particular, is under a deep debt of gratitude to Professor Hughes for his simple and beautiful instrument, which I have christened the audimeter, or less correctly but more euphoniously, the audiometer.

SUDRÉ'S THERMO-PILE.

IN designing his new form of thermo-pile, M. Sudré has had several objects in view. The characteristic points in the invention are: 1st. Low internal resistance of the couples under a very small volume, and the arrangement of these couples in chains in a particular manner, so as to facilitate their grouping together, and mounting; 2nd. The arrangement of the couples between heating and cooling surfaces; 3rd. The peculiar method of conducting the heat to the one set of metallic junctions; and 4th. The peculiar method of cooling the other set of junctions.

In designing the form of the bars of which the couples are composed, two points have to be considered—1st. The resistance; and 2nd. The tendency of the bar to become equally heated from end to end. Now, as M. Sudré points out, the resistance of a bar varies as $\frac{\text{length}}{\text{sectional arc,}}$ and if this proportion be preserved constant, the resistance will remain the same; but the greater the length of the bar, the slower will the heat diffuse itself along the bar. But if the bar be made very long and correspondingly large in sectional area, great bulk will be obtained. The problem then is to determine what dimensions the bars should have to give the best effect consistent with smallness of volume. M. Sudré finds that for differences of temperature of from 10° to 120°, the bars should be 10 to 12 millimetres long, and for temperatures ranging up to 300°, from 20 to 30 millimetres long.

In short couples the method of soldering the points of union of the two diverse metals is a matter of the greatest importance. The junction should be made so that the one metal (in the form of a plate) should be in contact with the whole of the surface of the section of the bar, but at the same time should not penetrate to any depth in the latter, for the effect of its so doing would be to much diminish the electro-motive force of the couple. To obtain this double object, the extremity of the plate forming a couple is cut in the form of a comb (fig. 1), the teeth of which are twisted on themselves, as shown by fig. 2, so that whilst the surface of the twisted metal remains the same, its length becomes much reduced. The twisted cut portions form the connections on to which the bars are cast.

The plate with the twisted prolongations is best, as shown by fig. 2.

Each side of the full part G of the plate is coated with silicate of soda or other heat resisting material.

The mould in which the alloy bars are cast is shown by fig. 3. It is composed of a base C, two side pieces A B, maintained parallel by two cross pieces K and K', and of a cover D, carrying a longitudinal furrow pierced with holes, *d*, equal in number to the number of couples to be contained.

The plates being prepared as described, are placed in the mould between the two side pieces A B; the cover D is then placed on the top and the melted alloy run in, so that the series of plates become bedded in blocks of the alloy, as shown by fig. 4.

The chains of blocks so formed are arranged in the following manner:—

Two metallic plates, A and B, fig. 5, which are represented as planes but which may be cylindrical or curved, are covered on one side with a thin layer of an electrically insulating substance such as enamel. Between these two isolated surfaces is placed one or more of the thermo-electric chains, in such a manner that the extremes of the couples rest upon the enamel surfaces. If several chains are arranged side by side between the two same plates, then they must be arranged so that the opposite poles of two contiguous chains are side by side;

fig 1.

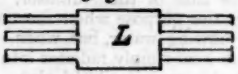


fig 2.

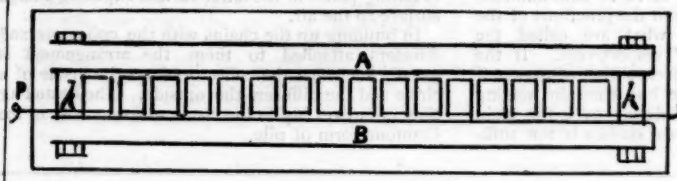


fig 3.

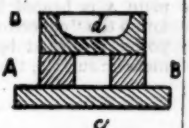


fig 4.

fig 5

fig 6.

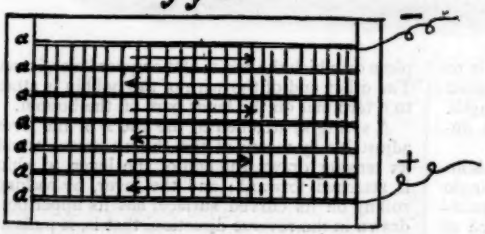
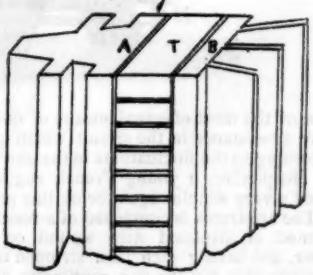


fig 7.



by this means they can easily be coupled up in "tension." Fig. 6 shows in plan the arrangement of several chains. The contiguous chains are isolated the one from the other by bands *a*, *a*, *a*, *a*, of calorically and electrically insulating materials. All the elements of the chains are electrically insulated from one another by the thickness of the plates, but they are not calorically insulated, so that if plate A is maintained at a high and plate B at a low temperature, the heat will flow across the isolated beds and penetrate the couples, across which it will continue its course from one soldering to another.

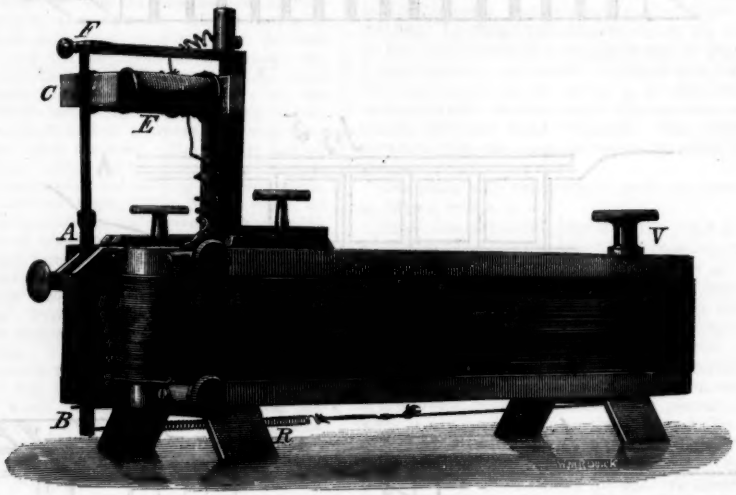
The plates A and B which serve to communicate and withdraw heat to and from the junctions of the couples, form portions of what are called the "collector" and "diffuser," respectively. If the plate A is heated by the direct action of steam it forms the "collector" proper, but when the heating power is heated by gas circulating over the plain metallic surface, then this plain surface is not sufficient to collect the heat and communicate it to the metallic couples. In such cases the surface of the metal is ribbed or has channels formed in it through which the heated gases circulate.

In the case of the "diffuser," the simple plate answers the purpose when the coating medium is simply flowing water, but when, as is usually the case, the heat simply radiates into the air, then the plate in this case is ribbed also. Fig. 7 shows the general arrangement of the "collector" and "diffuser." A is a rib of cast iron forming part of the the collector, and B is a part of the diffuser, the radiating plates in the latter surface exposing a large surface to the air.

In building up the chains with the collectors and diffusers attached to them, the arrangement is usually such that the collectors form the inside of a circle and the diffusers the outside. The heated air then circulates inside the circle so formed as in the Clamond form of pile.

HOSPITALIER'S ELECTRIC CURRENT REGULATOR.

IN a certain number of applications of electricity, such as the incandescence of platinum wires by the electric current, it is a very important point to maintain the current flowing at a certain strength, above or below which it must not vary appreciably.



One of the most effectual means of doing this is to have a resistance in the circuit which can be varied according to the fluctuations in the current strength. M. Hospitalier, a young French engineer, has devised a very simple regulator on this principle.

The apparatus is composed of a resistance bobbin formed of insulated wire wound on in a single layer, and having each turn stripped of its insulating covering for about a centimetre of distance at the same spot. A lever A B, slightly convex, can be made to touch at any particular part of its length the bared portion of the turn of wire immediately beneath that part. This lever, or "divider," has a joint at A, to which is connected a second lever having an armature C, fixed near its other extremity, which armature is placed in front of the electro-magnet E. One end of the wire of the electro-magnet is connected to one end of the wire on the bobbin, the other end is connected to the metal piece on which the end F, of the upper lever, is swung. The other end of the wire of the bobbin is attached to a terminal on the lever part of the bobbin.

A spring R, attached to the end B of the lever, is adjustable by means of the thumb screw V, and by its tension draws the end of the lever, to which it is attached, forward; and the lever, by rocking or rolling on its curved surface, has its upper portion drawn in the reverse direction, that is, it pulls away the armature C, from the electro-magnet. Under these conditions the lower part of the rocking lever

will be in contact with the bare place on the lowest turn of wire on the bobbin, consequently the major portion of the current conveyed by the wires connected to the two terminals on the bobbin flows from the bare spot on the wire, up the lever, and thence through the electro-magnet back to the second terminal. The armature being consequently attracted, the curved lever is made to rock or roll on the bared surfaces of the wires, thus making contact with turns of the wire higher up the bobbin; but when this is so, the current entering the lower terminal has to traverse all the turns up to the turn with which the lever may be in contact, and the current is thus weakened. Hence it is easy to see that when the spring R, is adjusted to a certain tension, the current flowing will, by pulling the armature C, pull the lower lever on to such a turn of the wire on the bobbin as will introduce an amount of resistance sufficient to produce equilibrium, and if the current weakens or strengthens, the lever will move backwards or forwards until the resistance adjusted by the decreased or increased number of turns in the circuit again produces equilibrium.

To adapt the apparatus for alternating currents, the electro-magnet is replaced by a bar or wire, which expands by the heating effect of the currents.

For dynamo-machines, the apparatus is arranged to be worked by the machine itself. This is done by connecting the rocking lever to a Watts's governor. Under these conditions the apparatus regulates the velocity of the machine, and not the strength of the current.

It is hardly necessary to call attention to the utility of the invention, but the importance may be well understood when we consider that the apparatus bears the same relation to the regulation of the electric currents as the Watts's and other governors, or to the regulation of the flow of steam in steam engines.

PACCINOTTI'S DYNAMO-ELECTRIC MACHINE.

THE novelty in the magneto-electric machine invented by Dr. Antonio Paccinotti of Pisa, in 1860, which we illustrate below, is the peculiar shape of the rotating electro-magnet, which is an iron ring, whose induced poles during rotation move constantly from one point to the other without interruption. About this iron ring coils of isolated copper wire, *a*, fig. 1, were placed, which were connected with each other so as to form a continuous wire. From each connection a conducting wire was brought to metallic pieces *b* of the same number, laid parallel to, and isolated from, each other around the shaft carrying the ring.

FIG. 1.

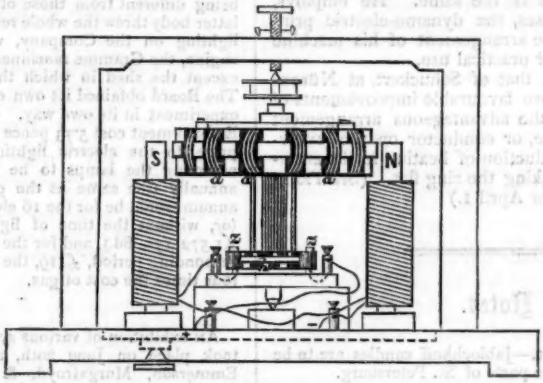
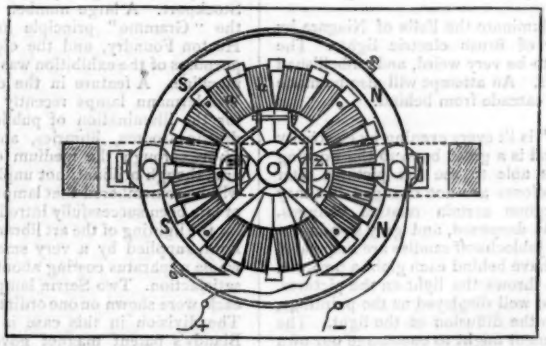


FIG. 2.



The ring was arranged horizontally, and on each side of the diameter was placed one pole of a powerful electro-magnet ending in elongations of soft iron S N, fig. 2, enclosing about one-third of

the ring on each side. Two rollers *z*, were placed opposite each other, in contact with the above isolated metal pieces, to take off the current when the machine is driven by mechanical power, or to let the current coming from a source of electricity into the ring, when action of the machine is reversed, and motion derived from it by means of electricity. Both actions are provided for by Paccinotti in the description of his apparatus.

It will be seen that this machine involves the principles on which are built the recent generators of electricity. Full importance, however, was only given to Paccinotti's invention after Dr. W. Siemens and Wheatstone, in the year 1867, discovered the dynamo-electric principle, which enabled a machine itself to produce the highest magnetism in its electro-magnets from very feeble residual magnetism in its cores to begin with.

The machine invented independently by M. Gramme, at Paris, in 1870, contained several improvements in construction, and it was left to him to bring this mode of generating electricity into the extensive use obtaining now, though the chief part of his machine is the ring of Paccinotti, with the same principle of action as the Gramme ring.

Gramme used a ring covered with coils in the same manner as Paccinotti, and his process of inducing the currents is the same. He employs, however, in most cases, the dynamo-electric principle; and the whole arrangement of his machine is well calculated for practical use.

Another machine, that of Schuckert, at Nürenberg, shows still more favourable improvements of Paccinotti's ring by the advantageous arrangement of the induction wire, or conductor on the revolving ring, and the reduction of heating in the armature, secured by making the ring flat. (*See* TELEGRAPHIC JOURNAL for April 1.)

Notes.

THE ELECTRIC LIGHT.—Jablochkoff candles are to be set up at several public parts of St. Petersburg.

IT is proposed to illuminate the Falls of Niagara by night with a number of Brush electric lights. The spectacle is expected to be very weird, and embellished with artificial rainbows. An attempt will also be made to light up the falling cascade from behind.

THE Paris "Salon" is lit every evening by electricity from 8 to 11 p.m., and is a great boon to the working classes, who are thus able to see the pictures after labour hours. The colours are not changed, but they seem to have undergone certain relative changes. Green, for instance, is deepened, and gray stands out in bolder relief. The Jablochkoff candles are suspended from the ceiling, and have behind each globe a powerful metal reflector, which throws the light on the pictures. The sculpture is not so well displayed as the paintings, owing to inequality in the diffusion of the light. The success of the experiment ought to encourage our own Royal Academy authorities to adopt the plan for their exhibition in Burlington House.

SIEMENS' electric light is to be tried in the Reading Room of the British Museum for a period of three months. A new Siemens' lamp, which is said to give excellent results, will be employed.

COLONEL HAYWOOD, C.E., the Engineer to the City Commission of Sewers, in a report just issued to them, observed that it might be desirable to set before the Commission what was the amount of light on the Holborn Viaduct, calculated from the Board's data. The light given by the ordinary batswing burner, consuming five cubic feet of gas per hour, was equal to that of about 14 sperm candles. The electric light on the Victoria Embankment, which was similar to that on the Viaduct, was found to be, with the naked light, equal to 378·1 sperm candles, and when enclosed in opal globes, 154·9 sperm candles, the loss by the use of the opal globes being about 59 per cent. of the whole light. There were 16 electric lights in opal globes on the Viaduct, and they displaced, when burning, 86 five-feet batswing burners. The relative lights were from 86 gas burners, 1,204 candles; 16 electric lights naked, 6,049·6 candles, or 16 electric lights in opal globes, 2,478·4 candles. Thus the electric light on the Viaduct, when naked, gave about five times that of the ordinary gas light, and, as enclosed in opal globes, about twice as much. The cost of the electric lighting on the Embankment was less, proportionately, than that on the Viaduct, the arrangements made by the Metropolitan Board of Works being different from those of the Commissioners; the latter body threw the whole responsibility of the electric lighting on the Company, who provided the steam engine, the Gramme machines, and everything needed, except the shed in which the apparatus was placed. The Board obtained its own engine, and conducted the experiment in its own way. Each electric light on the Embankment cost 5·73 pence per hour. Applying that price to the electric lighting on the Viaduct, and assuming the lamps to be kept alight 4,300 hours annually (the same as the gas lamps), the cost per annum would be for the 16 electric lamps, £1,642 12s., (or, without the time of lighting and extinguishing, £1,572 17s. 8d.), and for the 86 gas lamps for a corresponding period, £419, the electric light being nearly four times the cost of gas.

AN exhibition of various systems of electric lighting took place on June 20th, at the works of Messrs. Emmerson, Murgatroyd, & Co., Heaton Foundry, Stockport. A large number of different machines on the "Gramme" principle are being constructed at Heaton Foundry, and the electricity required for the purposes of the exhibition was produced by the Gramme machine. A feature in the exhibition was six of the Werdermann lamps recently introduced, and suitable for the illumination of public halls, picture galleries, drawing-rooms, libraries, and the like. The light given through the medium of these lamps is steady, and, though brilliant, not unpleasantly powerful; and it will be remembered that lamps of the same make have of late been successfully introduced at South Kensington for the lighting of the art library. A single Werdermann light, supplied by a very small Gramme machine, the whole apparatus costing about £40, gave considerable satisfaction. Two Serrin lamps, of about 1,200 candles each, were shown on one ordinary "A" Gramme machine. The division in this case is effected by means of a Blandy's patent magnet governor coil, and marks a great step in advance. A capital method of utilising the electric light by reflection was also shown. A lamp was swung below the roof of the building, and the light thrown upon the ceiling, falling thence below into the workshop. The light so obtained was particularly soft

and much resembled daylight, whilst every part of the building was well illuminated. The great power of penetration of the light, rendering it valuable for naval, military, and mercantile marine purposes, was shown by means of a parabolic reflector placed on a lamp. It is stated that small print can be read in the rays of this light at a distance of a mile and a half from the lamp.

THE volunteers of Northampton are about to lead the way to a further use for the electric light. Arrangements have been concluded with the British Electric Light Company to light the camp of the 3rd Northamptonshire Rifle Volunteers during a week's camping at Northampton. For this purpose the Gramme machines will be used in conjunction with powerful electric lamps.

WE hear that Werdermann's lamp is to be taken up by the British Electric Light Company.

DR. HOPKINSON in his evidence before the Parliamentary Committee on Electric Lighting, stated that his experiments showed about 50 per cent. of the electricity obtained from the mechanical energy of the machine was lost in heating the wires and parts of the machine. Mr. Shoolbred, the well-known draper, Tottenham Court Road, stated that he now used 20 electric candles instead of 230 gas jets, the cost of the candles being 37s. 3d. per night in winter, and 9s. 10d. in summer.

TEMPERATURE OF THE ARC.—M. Rosetti, Professor at the University of Padua, has found the temperature of the voltaic arc produced by eighty Bunsen elements to be 3,500° C., that of the positive pole 2,870° C., and that of the negative pole 2,400° C. With fewer cells the temperature was lower. His results were obtained by measuring the amount of radiation.

THE TELEPHONE.—A very exhaustive little treatise on the telephone, by Mr. Conrad Cooke, will shortly be issued by the proprietors of *Engineering*.

THE MICROPHONE IN MINES.—The use of the microphone as a detector of the signals made by imprisoned miners by blows on the coal rock has been suggested. Were the Morse or other code put into the hands of miners these signals might be rendered intelligible.

A PACIFIC CABLE.—That eventually a cable will be laid from the Pacific Coast to the Sandwich Islands, Japan and China, there can be no doubt. When this line is established the telegraphic circuit of the world will be complete. Mr. Cyrus W. Field holds an exclusive concession from the government of the Sandwich Islands for such a cable, as was announced at the recent celebration of the twenty-fifth anniversary of the organization of the company which resulted in laying the Atlantic cable. Concessions will also be obtained from Japan, and probably from China. We understand that the organization of a company to carry out this project is proposed, and that Mr. Field has agreed to contribute 100,000 dollars in cash as a subscription to its capital stock. It is expected that capitalists upon the Pacific coast, who will naturally feel a pride in the establishment of such a line, will also contribute liberally to give the project a start and carry it through. The business interests of the coast would be greatly facilitated by such a connection. Mr. Field sailed for Liverpool on the 21st ult. in the Cunard steamship *Bothnia*, and during his sojourn in England will make such investigations in regard to the manufacture and laying of a Pacific cable as will enable him and his associates to act understandingly in furthering the proposed enterprise. No steps will be taken towards organizing a company until after the return of Mr. Field. It is to be hoped that sufficient encouragement will be extended to insure the construction of the line at no distant period.—*The Journal of the Telegraph*, U.S.

AN Indian paper states that bamboo telegraph poles are being shipped from Madras to Natal.

COWPER'S TELEGRAPHIC PEN has worked between Waterloo and Woking, on the South Western Railway. This distance is 26 miles, but resistance was added to the circuit to make it equivalent to 100 miles. It worked well, and the only disturbance from induction currents on neighbouring wires was an occasional tremor of the pen.

THE July number of Mr. Edmund Yates' new magazine, *Time*, contains a paper by Mr. Scudamore and an article descriptive of the Central Telegraph Station.

TROUVÉ'S POLYSCOPE has been re-invented by a young Saxon doctor, named Nitze, and termed an endoscope. It consists of a platinum wire kept red hot by an electric current, and enclosed in a glass bulb, and is designed to illumine the cavities of the body. Messrs. Coxeter and Sons also exhibited a similar apparatus at the *conversazione* of Telegraph Engineers.

THE new German-Norwegian Cable is expected to be laid in August.

ASSAYING BY INDUCTION.—In our article on this subject, in our last number, we stated that variations in the composition of alloys not exceeding the one ten-thousandth part could be indicated by Professor Hughes' induction balance, "a degree of accuracy which far exceeds any known method of analysis." Mr. Chandler Roberts points out to us that this statement is not quite correct. He is satisfied that, under certain conditions, the induction balance will show smaller variations than those we indicated; but, on the other hand, even in the ordinary method of assaying gold, the probable error is included within a range of two ten-thousandths, that is, an error of plus or minus one ten-thousandth.

AMONG the enemies of underground telegraph lines in England, Mr. W. H. Preece describes a species of fungus and an insect called the *Tempeltonia Crystallina*.

IT is proposed to have a special electrical section in the Scientific Exhibition to be held in Paris from July to November next.

MAGNETIC IRONSTONE.—Herr Narr finds that the specific magnetism of magnetic ironstone is greater than that of any other magnetic substance known. Its permanent magnetism exceeds that of glass-hard steel, and is sooner neutralised by external forces than that of steel.

INDUCTION SPARK IN VACUO.—M. Du Moncel has pointed out that the dark space seen surrounding the negative pole in a Crooke's vacuum can also be observed by the microscope; also in the case of an induction spark in air.

WE have received from M. Gazau de Vantibault, President of the Trans-Sahara Commission, a pamphlet advocating in eloquent language, the construction

of a railway and telegraph line from Algeria to the Soudan.

THE AMERICAN RAPID TELEGRAPH COMPANY, says the *Engineering and Mining Times*, U. S., is the title of a new organisation just formed, which is affirmed by newspaper report to be the owner of valuable improvements that will enable it to materially cheapen existing telegraphic rates. One of the novel inventions it is reported to control, but of which no published description has yet appeared, is a system of transmitting 1,000 words per minute. The following are among the reforms which the public are promised when the new organisation is once at work: (1.) Immediate despatches (express messages) will be transmitted to all stations east of the Rocky Mountains at the uniform rate of 25 cents for 30 words. (2.) Mail messages will be dispatched within an hour, and delivered through the nearest post-office, or by messenger within two hours from time of reception, at 25 cents per 50 words. (3.) Press reports, for exclusive use of one paper, at 10 cents per 100 words. (4.) Night messages, to be delivered before 9 a.m., at 15 cents per 50 words. (5.) Stamped messages, a novel suggestion, by which, with the co-operation of the Postal Department, a postal telegraphic system, using special stamps, will facilitate rapid transmission of business by telegraph. The company, it is affirmed, promise within three years to telegraph ordinary business letters to and from all points of the country for 10 cents. The company, it is further affirmed, will at once set about constructing a double line of wires to connect the principal cities of the Union east of the Rocky Mountains, using the highways and post-roads, which the law of 1866 leaves them free to use.

The "Electro-mechanical Telegraph," the "Real Duplex Telegraph," the "Multiplex Telegraph," the "Metrical Telegraph," the "Line and Page-printing Telegraph," the "Electric-generating Machine," and the "Speaking Telephone," are the somewhat revolutionary implements of the new adventurers.

Proceedings of Societies.

PHYSICAL SOCIETY.—JUNE 14TH, 1879.

Prof. W. G. ADAMS in the Chair.

New Members—DONALD MACALISTER, B.A., and Mr. ST. GEORGE LANE FOX.

PROF. MACLEOD described a plan for suppressing the induction disturbances in a telephone circuit. It is known that a secondary battery composed of metal plates and sulphuric acid allows weak currents to pass while stopping those of high tension. Prof. Macleod had inserted a secondary battery of platinum plate between the line and the telephone, but this stopped both the induction and the vocal currents. When platinum wires were substituted for the plates, however, the induction currents were stopped, while the vocal currents could be feebly heard.

Dr. O. J. LODGE exhibited his new reversing key for electrometer work, which is illustrated on another page.

Mr. J. F. MOULTON then demonstrated the results of the experiments of Mr. Spottiswoode and himself on the sensitiveness of electric discharges in vacuum tubes. These experiments were undertaken to find the cause of the luminous layers or strata in the discharge, a Holtz machine being employed. It was observed that when feeble currents were drawn from the machine, the discharge could be depressed by laying the finger on the tube, and this depression always occurs with intermittent currents, therefore the feeble currents form a continuous current. Holtz discharge themselves, like intermittent currents, by reason of their feebleness. This sensitiveness of the discharge to the approach of the finger was found to be due to the conductivity and electric capacity of the hand. Electricity opposite in kind to the discharge is induced on the finger, and streaming upon the tube, neutralises part of the discharge therein. This effect was also shown by means of tinfoil rings round the tube. An intermittent current is of course capable of this static induction on neighbouring conductors. The luminous discharge in a vacuum tube consists of a bright sharp glow at the negative terminal, followed by a dark space, then a hazy bluish light at the positive pole. The striæ or layers in these sensitive tubes merely repeat this appearance. They can be artificially produced by placing the fingers, or rings of metal at intervals along a tube conveying an amorphous discharge; for in this case the induced electricity discharging itself from the fingers, breaks up the amorphous discharge into dark and bright layers. In these stratified discharges the electricity appears to travel *per saltum*, or by stepping-stones, as one may say, and the glow seems to be a molecular structure, a view which is supported by Mr. Crookes's experiments. A negative discharge from the finger produces a dark space in the tube discharge, and a positive one a bright line; therefore one can tell the kind of discharge passing in a tube by laying a finger on it. If the same pole be brought to both ends of a tube a discharge will still take place from each end, and there will be a dark space in the middle, the electricity here seeming to turn back again the way it came. The discharge from a pole through a vacuum tube would therefore appear to be not akin to conduction, but to a disruptive discharge. It is a leap in the dark, and the phenomena observed are due to the gaseous nature of the medium. These experiments point to the possibility of completing a circuit by positive electricity alone. Prof. Guthrie suggested that by combining vacuum tubes with the conduction balance of Prof. Hughes it might be possible to get an optical balance for measuring inductive capacity.

Dr. HENRY DRAPER, of New York, who is now on a visit to England, then addressed the meeting on his alleged discovery of oxygen in the sun by bright lines in the solar spectrum. He said that hitherto he had not been able to find these lines projecting from the limb of the sun, like hydrogen, and his impression is that oxygen resides lower than the reversing layer. He had lately been extending the dispersion of the spectrum of terrestrial oxygen, and from a light of maximum intensity of 1 candle power had now got a dispersion of eighty inches from A to O. He exhibited two of the original negatives of the solar spectrum showing the bright line.

Mr. J. NORMAN LOCKYER congratulated solar science on having so able a worker as Dr. Draper, and remarked that if Dr. Draper proved his case for even two or three O lines it would be sufficient, considering the variability of the spectrum of matter under different physical conditions. He also alluded to the traces of carbon which he himself had found in the sun by the dark flutings in the spectrum.—Dr. Draper said he did not see why carbon should not give both bright and dark lines. Mr. Scott exhibited a number of coloured photographs done after the method of M. Albert, of Munich.

AT an extra meeting of this society, held at Coopers' Hall Indian Engineering College, on June 21st, Lord Rosse in the chair, Prof. UNWIN read a paper on "The Friction of a Solid Moving in a Liquid"; and Lieut.

G. S. Clark, R.E., described an "Optical mode of Determining the Absolute Pitch of Tuning Forks."

Prof. MACLEOD then described an electric pendulum used in the foregoing experiments. The zinc and steel communicating pendulum moved by its own gravity, but at each swing it made and broke a current by means of two bent springs, one on either side. The current passing through an electro-magnet detains a bent lever until the pendulum swings to the other side. By this contrivance the time is marked. Prof. Macleod found that the platinum contacts frequently stuck together in these experiments; but this defect had been cured by the use of a liquid shunt of dilute sulphuric acid, which destroyed the extra current. This remedy had been suggested to him by Lord Rayleigh. Prof. Macleod demonstrated the entire success of this device, which acts as well as a condenser shunt. He has also observed a curious effect with these liquid shunts which, as yet, he could not explain. Two shunts, having the same acid in both, were employed, one shunting the extra current from four Daniell cells, and one that from two Daniel cells. The first showed evolution of H and O, gas platinum electrodes being unaffected. The second showed no evolution of gas, but one platinum plate was dissolved away and deposited in a black powder on the others. He also exhibited a new cell formed of zinc and mercury plates with zincic iodide solution and mercurous chloride salt. Red iodide is formed at the negative electrode. The E. M. F. is $\frac{1}{10}$th of a Daniell cell, but the internal resistance is very low, and the cell very constant, while there is no local action.

Prof. GUTHRIE suggested that as the extra current was really a succession of sparks, the platinum might be carried bodily over from one electrode to the other. Mr. F. H. Varley stated that Mr. F. Higgins had observed a similar effect with carbon electrodes in a voltameter, one carbon falling away into a fine powder, and due, perhaps, to the disintegrating action of liberated gases. He had also himself seen a platinum wire in contact with a carbon, one eaten thin and drawn into very fine silky pens, while carbon was stained blue, although the current passing had very low tension. Mr. Chandler Roberts suggested that perhaps a hydride of platinum was formed in the cases mentioned by Prof. Macleod. Prof. Guthrie suggested experiments with fluorescent liquid shunts in the dark.

Mr. J. W. CLARK then described some experiments on the surface tension of liquid sulphurous anhydride, sealed in a capillary tube within a second tube containing the same substance. He found that at low temperatures the level of the liquid is lower in the narrow than in the wide tube. As the temperature rises the meniscus in the narrow tube descends till about 156° F., then it is level with that of the wider tube; both surfaces are slightly concave at this temperature. The surfaces become plane, then convex, the level in the wide tube becoming higher as the temperature rises higher. These experiments are being continued, and his other results, will be communicated to the society.

Prof. GUTHRIE proposed a vote of thanks to Col. Chesney, principal of the college.

General Science.

TEMPERATURES OF LUMINOUS SOURCES.—According to the researches of Draper and Becquerel, when the temperature of an incandescent solid continuously increases its spectrum lengthens out at the violet end. This fact, therefore, furnishes three modes of measuring the temperature of the luminous source—(1) by the wave length of the radiation which limits the spectrum towards the violet; (2) by the position of the thermal maximum of the spectrum, which approaches to the violet in proportion as the temperature of the emitter becomes higher; (3) by means of the ratio of the luminous intensity of a determinate radiation λ taken in the spectrum of the source, to the intensity of the same radiation in the spectrum of a source of known temperature, compared with the ratio of the luminous intensities of another radiation λ^1 in the same two spectra. Following these methods, M. Crova has recently compared the lights from the moderator lamp, the stearine candle, gas, lime light, electric light, and solar light, and he finds that the intensity of these lights weakens toward the violet rays in the order in which they are given, that is, when the intensity in the red rays is the same for all.

THE LIGHT REQUIRED BY GROWING PLANTS.—The recent researches of M. Best into this subject have demonstrated that the kind of light which fosters the growth of plants is that mapped out by the various absorption bands of the spectrum of chlorophyll, the green colouring matter of leaves. In his experiments M. Best found that plants kept under a green glass shade soon died, whereas those kept under red glass shades survived. Hence it appears that the light essential to the growth of plants must come from red rays, which are absorbed by the green glass. Also when green chlorophyll solution was substituted for the green glass the plants quickly died. In connection with this subject it has been pointed out by Mr. J. Munro that a great proportion of our common trees have the outer surfaces of their young leaf cases coloured a bright red, apparently for the purpose of turning them into light screens, which would allow those rays of the spectrum to pass which were favourable to vegetable growth, and quench those which were against it. From the researches of M. Yung it would also appear that whereas red light favours plant life it is pernicious to the life of animal germs, such as the spawn of frogs, the violet rays favouring the latter most.

OBSERVING FLASHING LIGHTS.—MM. Richet and Antoine Breguet find from experiment that there is a certain inert period before which the eye becomes sensible of lights. If the light is very brilliant like the electric spark this time is not appreciable, but for feeble lights it is observable. Feeble lights, lasting $\frac{1}{1000}$ of a second are not visible at all; but they can be rendered so either by increasing the intensity of the light or its duration, or by repeating it at least 50 times a second. Coloured lights obey the same laws and always appear of their proper hue.

GLAZED FROST.—This interesting natural phenomenon, which although frequent enough in Canada is very rare in Europe, was witnessed lately in the North of France. It is caused by freezing after a thaw, or by the immediate freezing of falling rain as in this case. In the forest of Fontainebleau great havoc was caused amongst the trees by the breaking of their ice-laden branches. Trees about a foot in diameter were completely crushed down by the weight of ice which they bore, and the damage is estimated at a million and a half francs. To give some idea of the effects produced, it is sufficient to cite the fact that a bough of ice-coated rhododendron which weighed 360 grammes, weighed, when thawed of its covering, only 13 grammes. Some of the grasses and plants sealed in their crystal cases were very curious and pretty. The telegraph lines were broken down at a number of points, under the weight of ice which encased them with a regular cylinder of ice 38 millimetres in diameter.

THE PLATINISATION OF IRON.—The incorrosive nature of platinum is well known, and its application to iron surfaces as a preservative from rust, is a problem which has long engaged the attention of metallurgists, though hitherto without any practical result. Monsieur J. B. A. Dodé, an eminent French chemist, claims to have solved this problem. He first paints the iron over with a composition of turpentine, borate of lead, oxide of copper and cobalt, and exposes it for a few minutes to a temperature of about 400 degrees. On cooling, the surface is again painted with a solution of chloride of platinum, combined with essential oils, and the object heated for a second time. When cool it is found to be covered with a permanent and homogeneous coating of platinum, rendering it impervious to rust, and unaffected by gas, atmospheric changes, and ordinary wear and tear. The gist of the discovery lies in the method of dissolving and holding the platinum in solution, and in applying it direct to the article treated, without any other aid than so low a temperature as not to affect the metal coated. The process, which is eminently suited for the preservation of telegraph wires and apparatus, has just been successfully carried out in London, and finished specimens may be seen at 18, Queen Victoria Street, E.C.

AN ELECTRICAL RAILWAY.

ONE of the most interesting novelties in the Berlin Exhibition is the construction of an electrical railway by Siemens and Halske. The electrical power is supplied by a dynamo-electric machine worked by a steam-engine to another dynamo-electric machine, which works the wheels of an electric locomotive. The length of the way is 200 metres, the velocity 3 metres per second; the number of waggons 3, and passengers 20. The same experiment will be tried at the Scientific Exhibition at the Paris Palais de l'Industrie, with Marcel Deprez's motor, which is very promising. A new model has been constructed, weighing seven kilograms, and with 12 Bunsen elements can give a man-power. This model of Marcel Deprez's is exhibiting now at Lille, on the occasion of one of the ascents of the Aëronautical Academy. It is hoped that it will have force enough to work an aërial helix for ascending and descending without any sacrifice of ballast and escape of gas.—*Nature.*

AUSTRALASIAN TELEGRAPHY.—Of the 588 miles of electric cable to be carried out by the steamship *Scotia*, in order to continue the line of telegraph already complete from Penang to Malacca, and thence laid nearly as far as Singapore, the end was wound on board on the 25th ult., from the Telegraph Construction and Maintenance Company's Works at Greenwich. This fine vessel of 4,600 tons, formerly a paddle ship in the Cunard fleet, and since altered to a double screw, with an additional deck, measures 379ft. in length, her beam being 48ft. She has engines of 500 horse-power, and her speed is 13 knots. A large company of guests, including many representatives of foreign countries, who are assembled to take part in the International Telegraph Congress, went down from Westminster Pier on a river steamer, and boarded the *Scotia* during one of the heaviest showers of the day.

The following are the final quotations of telegraphs for the 26th ult.:—Anglo-American, Limited, 55-55½; Ditto, Preferred, 84½-85½; Ditto, Deferred, 27-27½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6½-7½; Cuba, Limited, 8¼-8¾; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10½-11½; Direct United States Cable, Limited, 1877, 10½-10¾; Eastern, Limited, 7⅞-7⅛; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11¼-12; Eastern Extension, Australasian and China Limited, 7⅛-7⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10½-11½; Great Northern, 8⅛-8¼; Indo-European, Limited, 20½-21½; Mediterranean Extension, Limited, 2¼-3; Mediterranean Extension, 8 per cent. Preference, 8¾-9¼; Reuter's, Limited 9-10; Submarine, 225-235; Submarine Scrip, 2-2½; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference 8-8¼; Ditto, ditto, Second Preference, 7½-7⅞; Western and Brazilian, Limited, 3⅛-3⅜; Ditto, 6 per cent. Debentures "A," 96-100, Ditto, ditto, ditto, "B," 88-93; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 115-120; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 31-31½; Ditto, 6 per cent. Bonds, 109-111; Ditto, Second Bonus Trust Certificates, 2¼-2⅜; India Rubber Co., 12½-13; Ditto, 6 per cent. Debenture, 105-108.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £495,000.	Submarine Co. £338,925.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
May, 1879 ...	47,910	*12,810	3,100	984	15,970	38,371	25,845	18,917	... ...	11,452	... ...	124,30	5,526
May, 1878 ...	42,990	12,564	3,254	816	11,650	33,650	23,844	19,463	... ...	10,584	1,450	10,652	5,769
Increase	4,920	246	... ...	168	4,320	4,721	2,001	... ...	... ...	868	... ...	1,778	... ...
Decrease	... ...	... ...	154	... ...	... ...	... ...	... ...	546	... ...	... ...	... ...	... ...	243

* Four weeks against calendar month of last year.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness).